REMARKS/ARGUMENTS

Claims 19-25 were examined in the Office Action under reply, with claims 1-18 having been previously canceled. Claims 19-25 now stand rejected under 35 U.S.C. § 112, first and second paragraphs, and under 35 U.S.C. § 103 over Tuller et al. (U.S. Patent No. 4,042,550) and Lim (U.S. Patent No. 5,925,934) in view of Langari (U.S. Patent No. 6,261,871). The present rejections are addressed in part by the present amendments and are otherwise traversed for reasons that will be discussed in detail below. With the present amendments, claim 19 has been amended and claim 25 has been canceled.

Amendments

Claim 19 has been amended to define the present curing agent in terms of a Markush group to further clarify the present invention. Support for the maleic anhydride polymers comprising cyclohexane or norbornene can be found, for example, in the specification at ¶¶ [011], [013], and Schemes 1-5. Support for the maleic anhydride polymer comprising styrene can be found, for example, in the specification at ¶¶ [022]-[026]. No new matter has been added. As claim 19 has been amended to include the subject matter of claim 25, claim 25 has been canceled.

Claim Rejection Under 35 U.S.C. § 112, first paragraph

Claims 19-25 have been rejected under 35 U.S.C. § 112, first paragraph, for reciting that "wherein the molecular weight of the curing agent is greater than about 1000 g/mole," which the Examiner states is not supported in the specification or previous claims. According to the Examiner, ¶ [011] discloses a reaction scheme that contains a curing agent that appears to read on a variety of molecular weights, including those below 1000 g/mol.

While we agree that the reaction scheme of section [011] discloses a reaction scheme that contains a curing agent that reads on a variety of molecular weights, including those below 1000 g/mol, we believe that those molecular weights that are below "1000 g/mol" are molecular weights that are within the range of "about 1000 g/mol." For instance, considering the smallest value for each variable (i.e., n is 0, n' is 5, and R is methyl) of the low molecular weight polymeric cross-linker described in Scheme 1, the molecular weight of this cross-linker is about 971 g/mole, which we assert is about 1000 g/mol. Further, looking at the cross-linkers of, for instance, Schemes 2-5 on pages 7 and 8 of the specification, again considering the smallest values for each variable, the low modulus cross-linker of Scheme 2 has a molecular weight of about 1392 g/mol; the low modulus/higher reactive cross-linker of Scheme 3 has a molecular weight of about 1402 g/mol where R_1 is –OH and 1542 g/mole where R_1 is –COOH; the low modulus/higher adhesion cross-linker of Scheme 4 has a molecular weight of about 1928 g/mol; and the pendant anhydride cross-linker of Scheme 5 has a molecular weight of about 1251 g/mole. Thus, we assert that the "about 1000 g/mol" molecular weight amendment was supported by the specification.

As we have presently amended claim 19 to recite a Markush group for the curing agents and have deleted the "about 1000 g/mole" language from claim 19, this rejection is now moot.

Claim Rejection Under 35 U.S.C. § 112, second paragraph

As mentioned above, the pending claims were rejected under 35 U.S.C. § 112, second paragraph, because according to the Examiner, "it is not clear if [the] molecular weight limitation only applies to the situation wherein the curing agent is a copolymer comprising norbornene, or the curing agent in general." Claim 19 has presently been amended to define the curing agent in

terms of a Markush group to further clarify the present invention.. Thus, we believe that the § 112, second paragraph, rejection is now moot.

Claim Rejection Under 35 U.S.C. § 103(a)

Claims 19-25 have been examined in the outstanding office action and currently stand rejected under 35 U.S.C. §103(a) as being unpatentable over Tuller et al. (U.S. Patent No. 4,042,550) and Lim (U.S. Patent No. 5,925,934) in view of Langari (U.S. Patent No. 6,261,871). According to the Examiner, Tuller discloses a cured encapsulant resin composition that can be used as an underfill composition, as taught by Lim, and Langari discloses a method of fabricating a semiconductor device by the claimed steps and using an underfill composition therein.

Claim 19 has been amended to define the curing agent in terms of a Markush group to further clarify the present invention, which distinguishes the present invention from Tuller, Lim and Langari. As the molecular weight of the maleic anhydride polymer comprising styrene recites a molecular weight of "about 1600 g/mole," there is no overlap of ranges with Tuller. Furthermore, Tuller does not disclose the use of maleic anhydride polymers comprising cyclohexane or norbornene as presently claimed. Thus, it is respectfully submitted that Tuller does not teach a curing agent as presently claimed.

As stated in the present specification, previously known anhydrides that were used in underfill material were small molecules that have a tendency to volatilize during the curing process, which leads to porosity during the curing process and ultimately leads to system failure. *See* ¶ [008] of the present specification. The Examiner relies on the abstract and col. 2, lines 32-41 of Tuller, which describes the use of a hardener chosen from polyanhydrides of maleic acid

monomers and alkyl styrene monomers, and prepolymers of such polyanhydrides having molecular weights below about 1000. Applicants' curing agents, however, comprise low molecular weight polymers, wherein when the curing agent is a maleic anhydride polymer comprising styrene, the molecular weight is about 1600 g/mole. For instance, Examples 1-5 pertain to styrene/maleic anhydride copolymers of a molecular weight of about 1600 g/mole.

As mentioned above, if the molecular weight of the curing agent is too low, then the curing agent will volatize during processing and cause porosity during curing, which will lead to overall system failure. If the molecular weight of the curing agent is too high, then the curing agent will gel, which causes miscibility and flow problems during processing. By using low molecular weight maleic anhydride polymers containing different R groups, applicants have unexpectedly found that volatilization can be controlled (e.g., decreased), especially at high temperatures in, for instance, no flow underfill formulations or in any sudden exposure to high temperatures in a short time, thereby reducing flow problems such as voids and die fails.

The claimed invention is also distinguishable over Tuller with respect to the function of the present curing agents. As explained in ¶ [008] of the present specification, the known anhydrides "typically only perform one function, i.e. cross-linking." Greater cross-linking will result in a harder cured product. Tuller's polyanhydrides having a molecular weight below about 1000 only function as a hardener. While the Examiner states that "applying a styrene/maleic anhydride copolymer resin composition [of Tuller] as an encapsulant/underfill produces a composition with excellent moisture resistance and wet electrical properties, resulting in a high quality product," we respectfully assert that the Examiner mischaracterizes the function of the polyanhydrides of Tuller. According to the specification of Tuller, "It has been surprisingly found that the presence of the additional filler, silane coupling agent and lubricant improves the

moisture resistance of the electrical properties," not the use of polyanhydride hardeners. Col. 2, lines 6-10 of Tuller (emphasis added). In fact, the hardeners used in Tuller were not the alleged invention of Tuller at all, as admitted at col. 2, lines 14-16 of Tuller, but were disclosed in the prior art.

Thus, like other known anhydrides, the polyanhydrides of Tuller were only used as hardeners. Tuller is unlike embodiments of the present invention in which the low molecular weight maleic anhydride polymers are not only used to improve cross-linking, but can also be designed to modify viscosity, decrease moisture absorption, volatilization and modulus, improve mechanical properties, and/or enhance adhesion by substituting different R groups of the present curing agent. *See* ¶¶ [009] and [013] of the present specification. None of these other functions of the curing agent were disclosed or suggested in Tuller with respect to its polyanhydrides. The different structural designs of the present invention dictate different requirements for the curing agents themselves as well as the resin compositions containing the curing agents.

Overall, Tuller and Lim do not teach the presently claimed curing agent that can be used in an underfill composition of amended claim 19 and, as admitted by the Examiner, do not teach a method of fabricating a device as claimed. The combination of Tuller and Lim with Langari does not cure these defects. While Langari discloses a method of fabricating a semiconductor device, the Examiner did not cite Langari as disclosing the claimed curing agents and it is agreed that Langari does not disclose such. Further, the pending claims 20-24 are allowable as depending from allowable claim 19.

For all the above reasons, applicants respectfully submit that the pending claims define an invention that is novel and nonobvious over the art. An indication of allowable subject matter would be much appreciated.

The Examiner is invited to contact the undersigned at (408) 975-7500 to discuss any matter concerning this application.

The Office is hereby authorized to charge any additional fees or credit any overpayments under 37 C.F.R. §1.16 or §1.17 to Deposit Account No. **11-0600.**

Respectfully submitted,

KENYON & KENYON

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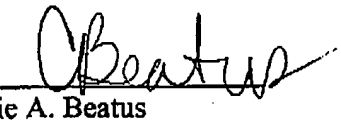
By: 
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